



Federal Aviation  
Administration

# Aviation Weather Research Program (AWRP)

Presented to: Aviation Weather Community Forum

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Date: April 16, 2009



# Agenda

- **AWRP Program Overview**
- **Research Areas**
- **Research-to-Operations Process (RTO)**
- **NextGen Research Requirements**
- **Summary**



# AWRP Program Overview

## Drivers/Rationale

- **AWRP contributes to the FAA Flight Plan as part of a portfolio of NextGen capability improvements to mitigate the impact of weather in the NAS via two goals:**
  - Increased Safety
    - reducing number of hazardous weather associated accidents
  - Greater Capacity
    - reducing impacts on capacity in operational NAS from adverse Wx Event
- **AWRP contributes to achieving NextGen goals by providing research that addresses needs identified in the JPDO Integrated Work Plan (IWP) including:**
  - Weather Forecasts – Consolidated icing, turbulence, convective, NCV, etc.
  - Foundational breakthroughs in atmospheric science
  - Network-enabled weather information
  - Etc.

## Outcome

- By 2012, development of timely and accurate deterministic (initial set of probabilistic) aviation weather forecasts for operational use in ATM, dispatchers, and pilots.
- BY 2016, development of improved accuracy of deterministic and an expanded set of probabilistic aviation weather forecasts for operational use by ATM, dispatchers and pilots.
- By 2020, advanced improvements in accuracy of deterministic and probabilistic aviation weather forecasts for operational use by ATM, dispatchers and pilots.



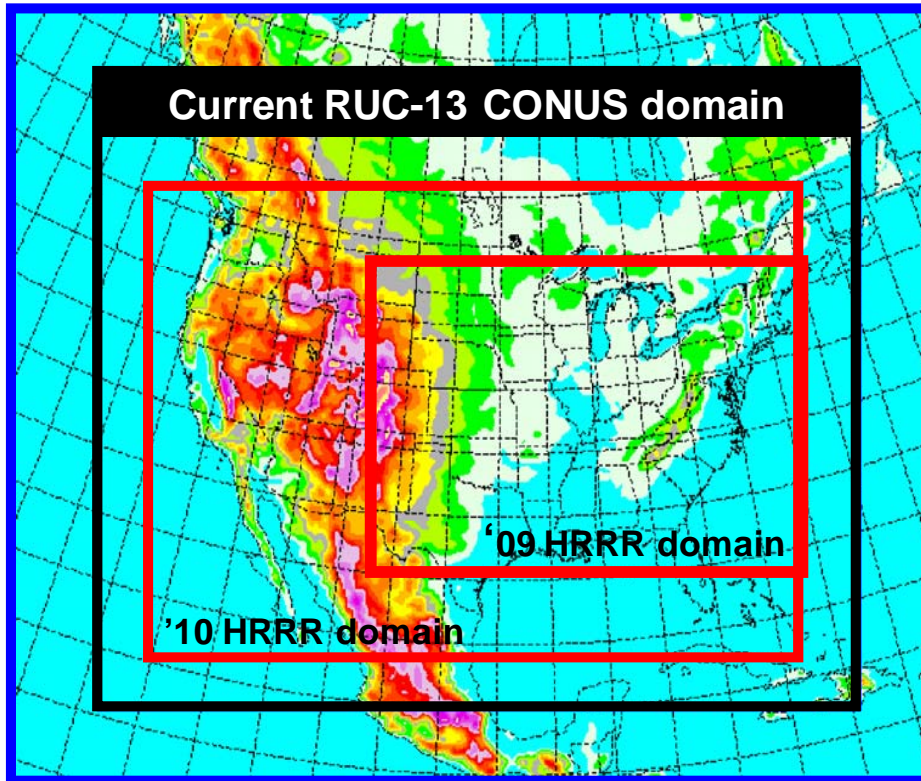
# Research Areas

- **Convective Weather**
- **Turbulence**
- **In-flight Icing**
- **National Ceiling and Visibility**
- **Volcanic Ash**
- **Model Development and Enhancement**
- **Advanced Weather Radar Techniques**
- **Quality Assessment**



# Convective Wx

## Advanced Storm Prediction Capability



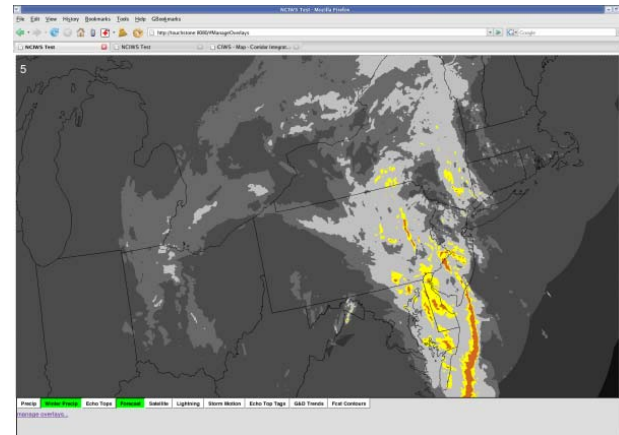
- CONUS Integrated Sensor Mosaics
  - Precip (VIL and Surface), Echo Tops, G&D Trends, Winter Precip, etc...
- Animated Forecast Loops
  - 0-2 hr – 15 min interval
  - 2-6 hr – 15 min interval
- Forecast Products (all 0-6 hr)
  - Deterministic Forecasts
    - Precip, Echo Tops
  - Probabilistic Forecasts
    - Convection, Snow,
  - Surface Fronts
- Disseminated based on NNEW stds
- Users will subscribe to output for generation of decision tools

## Next Gen Focus

- Foundational breakthroughs in atmospheric science to enable improved forecast skill
- Methodologies and Algorithms for Weather Assimilation into Decision-Making
- Trajectory management decision support
- Airspace/capacity/flow contingency mngmnt decision support
- Weather Forecasts-Consolidated Convective & Winter Storms
- Network-enabled Weather Information
- Aircraft Hazardous Weather Information Sharing

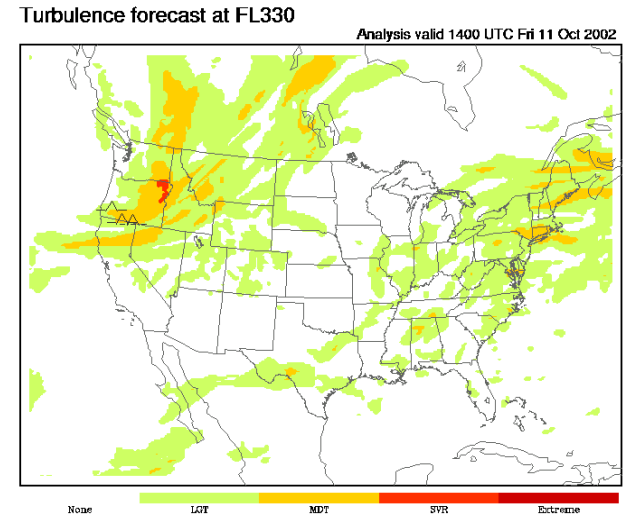
# Convective Wx Research Demo Summer '09

- **Experimental demo for research and user evaluation**
  - Human-in-the-Loop Evaluations
  - ATCSCC and selected users
- **Radar blended with high resolution, rapid refresh model**
  - VIL Forecasts
  - Echo Tops
  - 0-6 Hour forecast
  - Updates every 15 minutes
  - 3 km resolution
  - Northeast domain
  - On-line 24/7



# Turbulence

- **Graphical Turbulence Guidance (GTG)** – turbulence intensities for flight level 100+ out to 12 hours; updated hourly; utilizes RUC model and pilot reports
- **Planned efforts: GTG for all flight levels, Convectively- Induced Turbulence (CIT), Mountain Wave Turbulence (MWT), Alaska probabilistic Forecasts: inputs from radar, in-situ, and surface observations**



Accurate forecasts at any altitude.

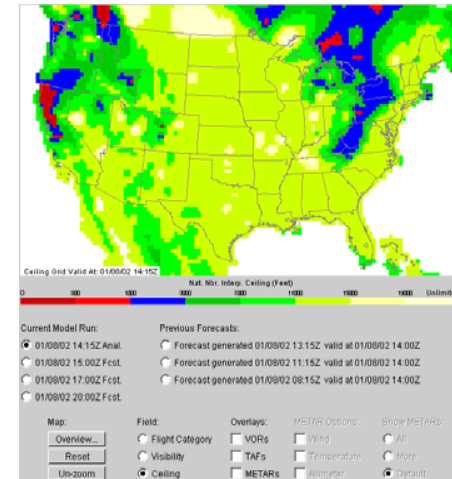
## NextGen Focus

- Network-enabled Weather Information
- Network-enabled Weather Observation System
- Weather Forecasts-Consolidated Turbulence
- Foundational breakthroughs in atmospheric science to enable improved forecast skill
- Aircraft Systems-Aircraft Hazardous Weather Information Sharing
- Enhance and Expanded Weather Sensors-Airborne Based

# National Ceiling & Visibility

- **Accurate and timely nowcasts/forecasts of ceiling, visibility, flight category conditions, to reduce accidents, especially for GA aircraft**

- **Analysis - 5 min updates, 5KM**
- **Probabilistic forecast (updated hourly to 12 hr), 5KM**
- **Products under development for CONUS and Alaska**



Accurate forecasts are critical to GA safety.

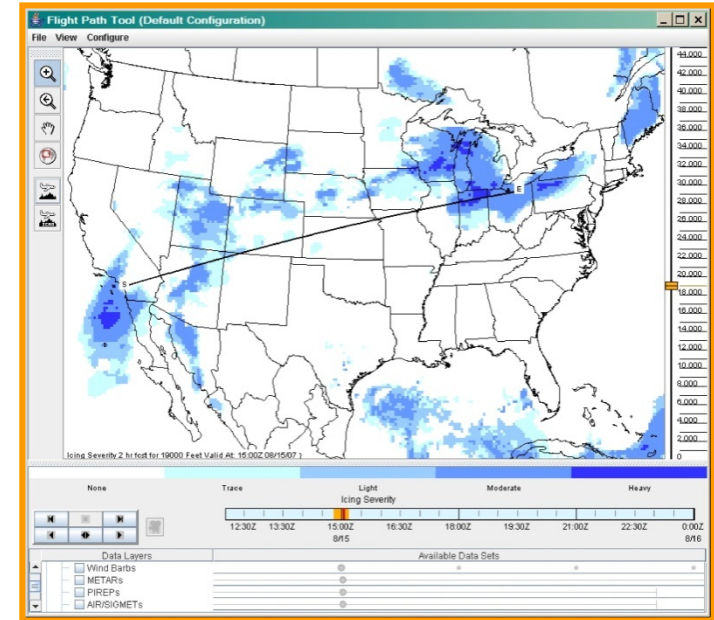
## NextGen Focus

- Weather Forecasts - Consolidated C&V
- Foundational breakthroughs in atmospheric science to enable improved forecast skill
- Methodologies and Algorithms for Weather Assimilation into Decision-Making



# In-Flight Icing

- Provide nowcasts/forecasts of atmospheric conditions conducive to airframe icing
- Current Icing Product (CIP) – severity, probability, super-cooled liquid droplet (SLD) potential, updated hourly; utilizes RUC model, satellite, surface wx obs, PIREPs
- Forecast Icing Product (FIP) – for 12- hr
- High Ice Water Content (HIWC) warning forecast, updated hourly, utilizes RUC model
- Planned efforts - Alaska & Global (oceanic routes)



## NextGen Focus

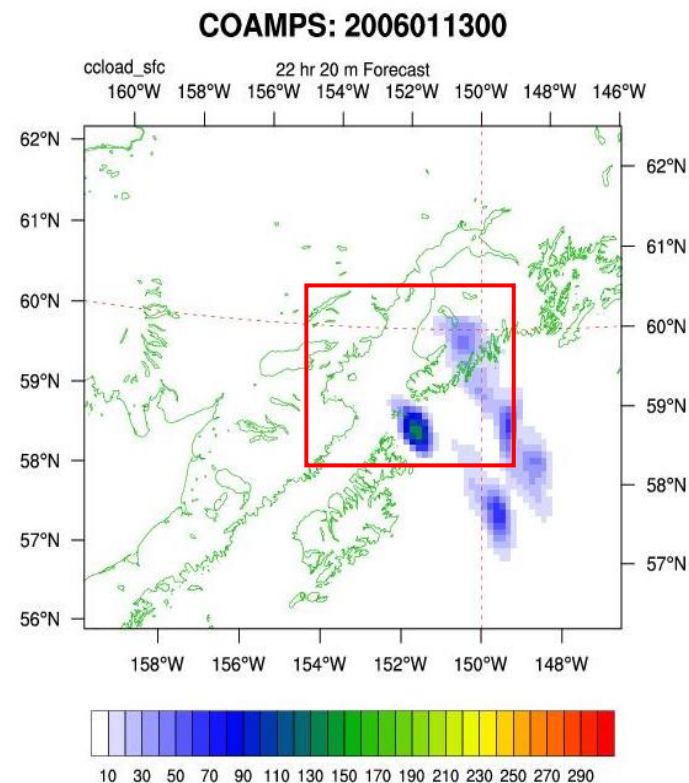
- Foundational breakthroughs in atmospheric science to enable improved forecast skill
- Network-enabled Weather Information
- Weather Forecasts-Consolidated Icing

# Volcanic Ash

- **Volcanic Ash Dispersion (VAD) forecasts as a decision support tool input for air traffic controllers on the DOTS and ATOP systems**
- **1-hour forecast updated every 6 hours; utilizes eruption parameters including height of plume, concentration estimates, time of eruption**

## NextGen Focus

- Network-Enabled Weather Information
- Aircraft Systems-Aircraft Hazardous Weather Information Sharing
- Foundational breakthroughs in atmospheric science to enable improved forecast skill
- Weather Forecasts – Volcanic Ash
- Weather Forecasts – Environment

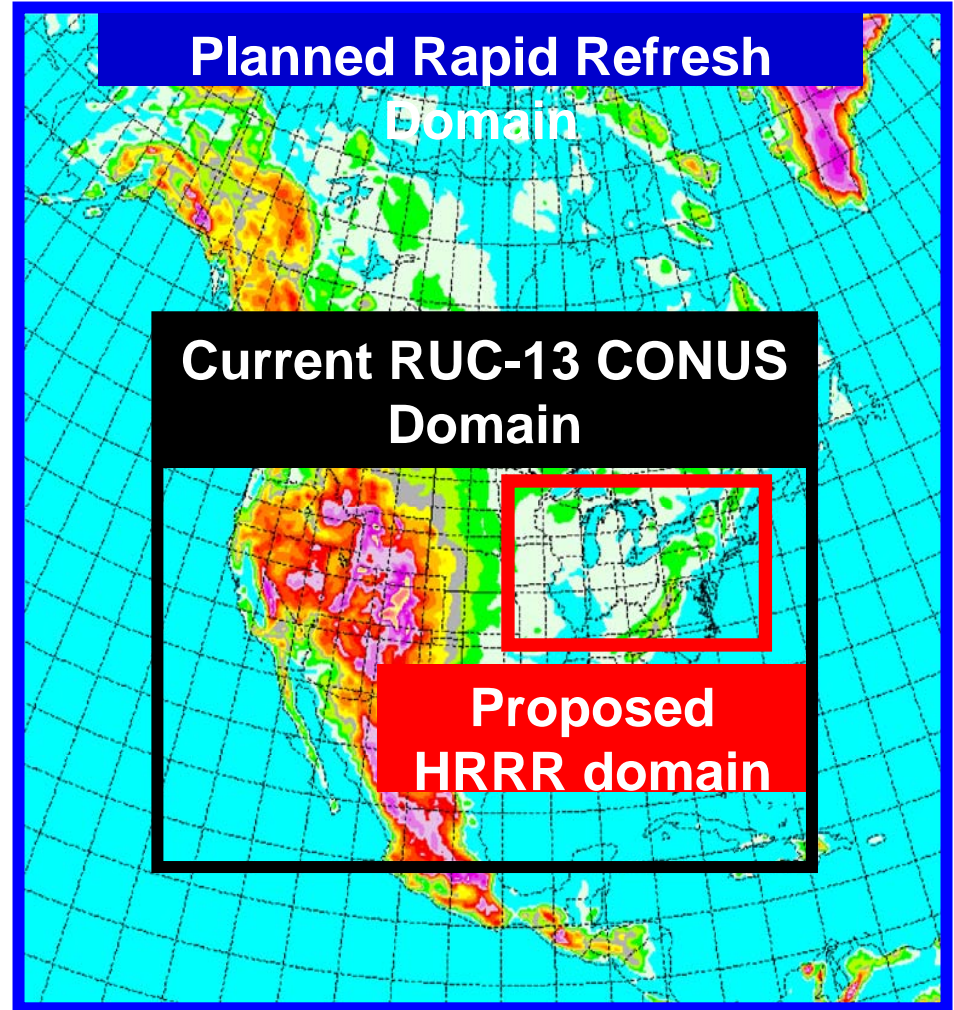


# Model Development & Enhancement

- **Weather Research & Forecast (WRF) Model:** Develop an advanced mesoscale forecast & assimilation system to promote closer ties between research & operations
- **Rapid Update Cycle – 13Km (RUC-13)**  
Resolution improved from 20 to 13Km. Improved accuracy for jet-level winds, temperature, In-flight icing, convection, turbulence, and ceiling and visibility
- **High-Resolution Rapid Refresh (HRRR)**  
Storm-resolving (3-km) model; updated every 30-60 min including latest radar data

## NextGen Focus

- Improve Weather Models
- Foundational breakthroughs in atmospheric science



# Advanced Wx Radar Techniques



## Objective

Development of techniques so that data from weather radars can be used to improve weather forecasting. Results of these efforts are used by other AWRP research areas to improve their forecast and nowcast capabilities

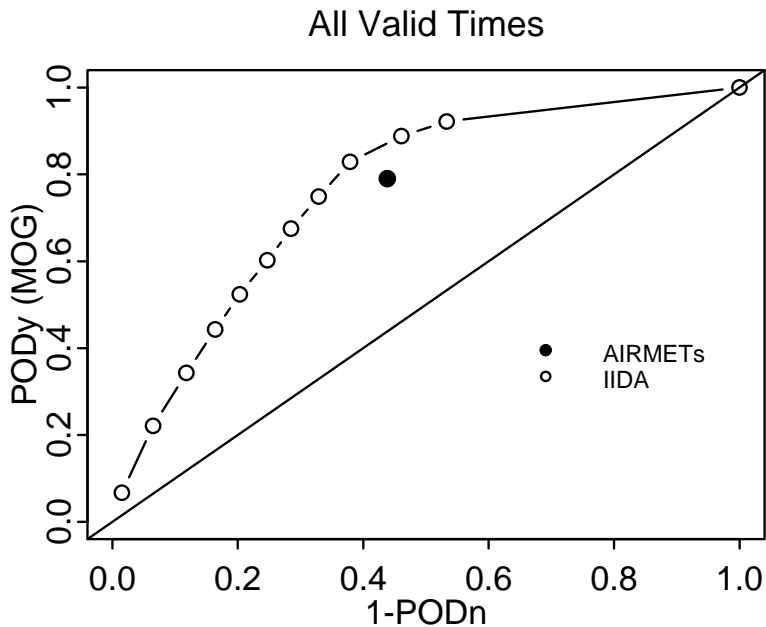
## Activities

- Update national radar mosaic to handle super-resolution NEXRAD data
- Improve icing forecasts via enhanced polarimetric measurements in low-reflectivity clouds
- Integrate Canadian radar data into real-time national 3D mosaic

## NextGen Focus

- Network-Enabled Weather Observation System
- Development of 4D radar-based weather situational awareness for TFM

# Quality Assessment



## Objective

Provide verification and assessment activities to support all AWRP algorithm development activities and NextGen implementation

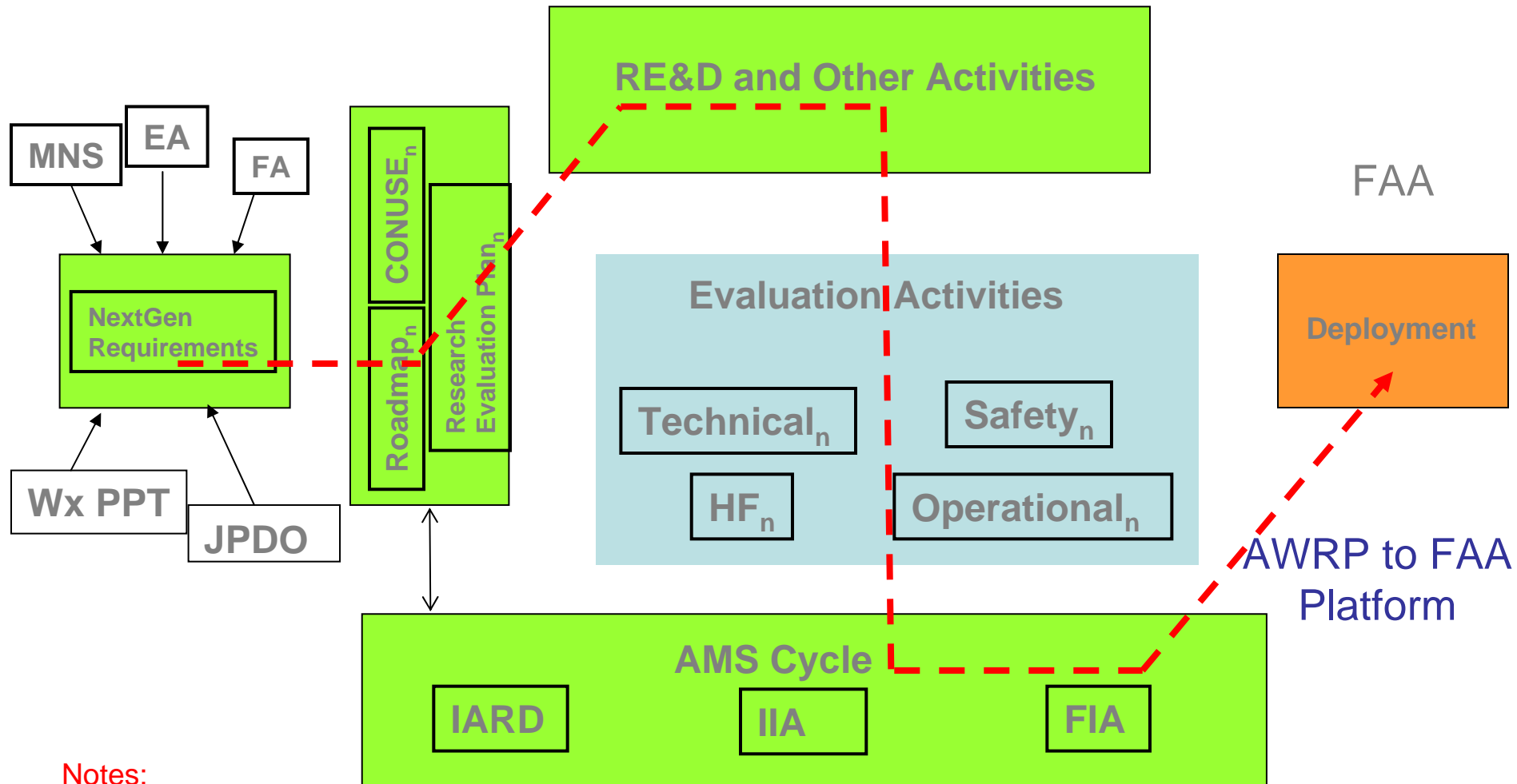
## Network-enabled Verification System (NEVS)

- Provide automated network-enabled web-based verification capability
- Provide automated aviation forecast performance scoring in real-time
- Provide the ability to join relevant air traffic information with meteorological verification information for aviation-specific scoring utilized for air-traffic impact assessments
- Effectively communicate forecast error and uncertainty information directly to automated decision support tools (DSTs)

## NextGen Focus

- Enhanced Weather Forecast Quality Assessment Techniques
- Real-time feedback on quality of data

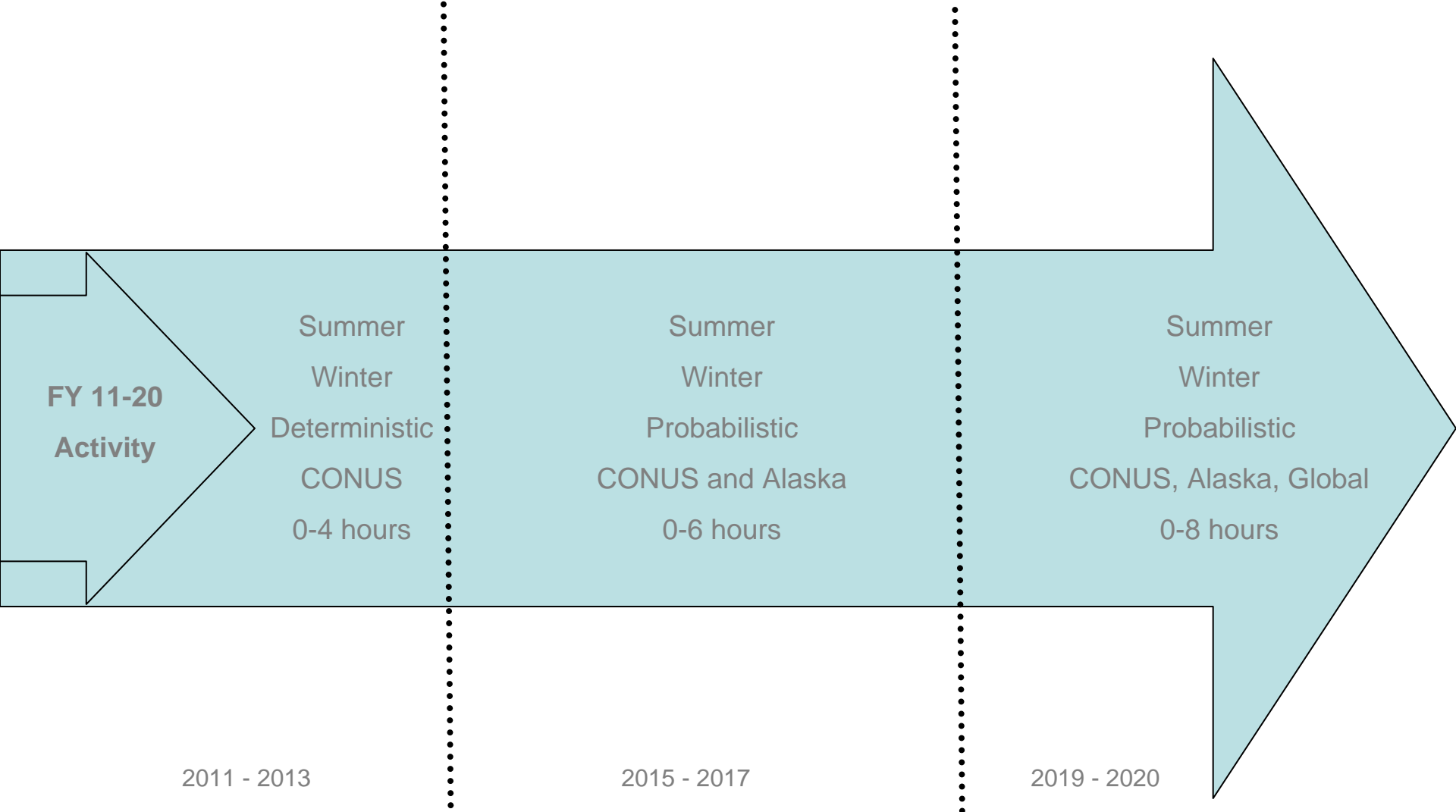
# RTO Process (AWRP to FAA Platform)



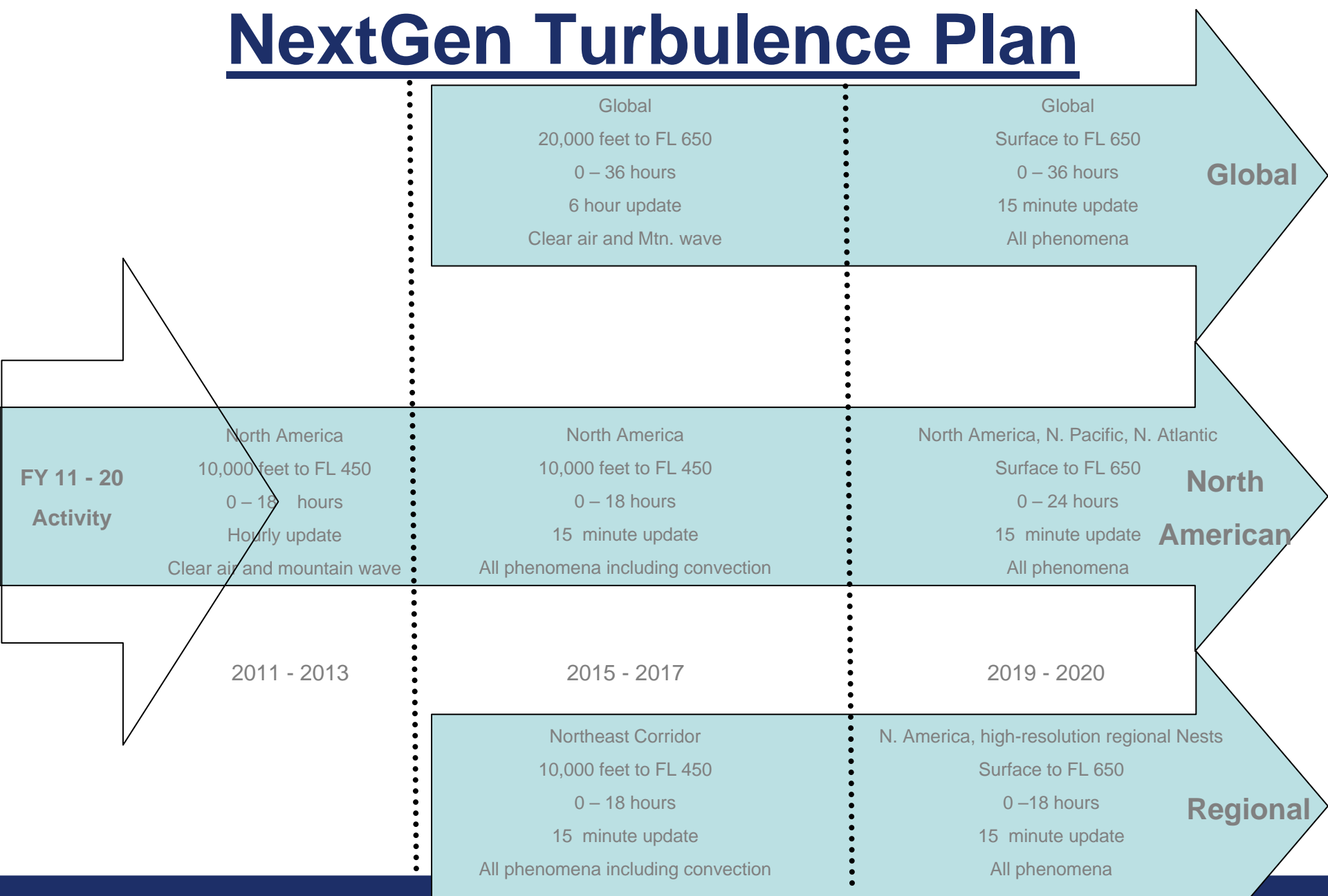
## Notes:

- 1)  $n$  = number of evaluations
- 2) diagram does not imply time

# NextGen Convective Prediction Plan

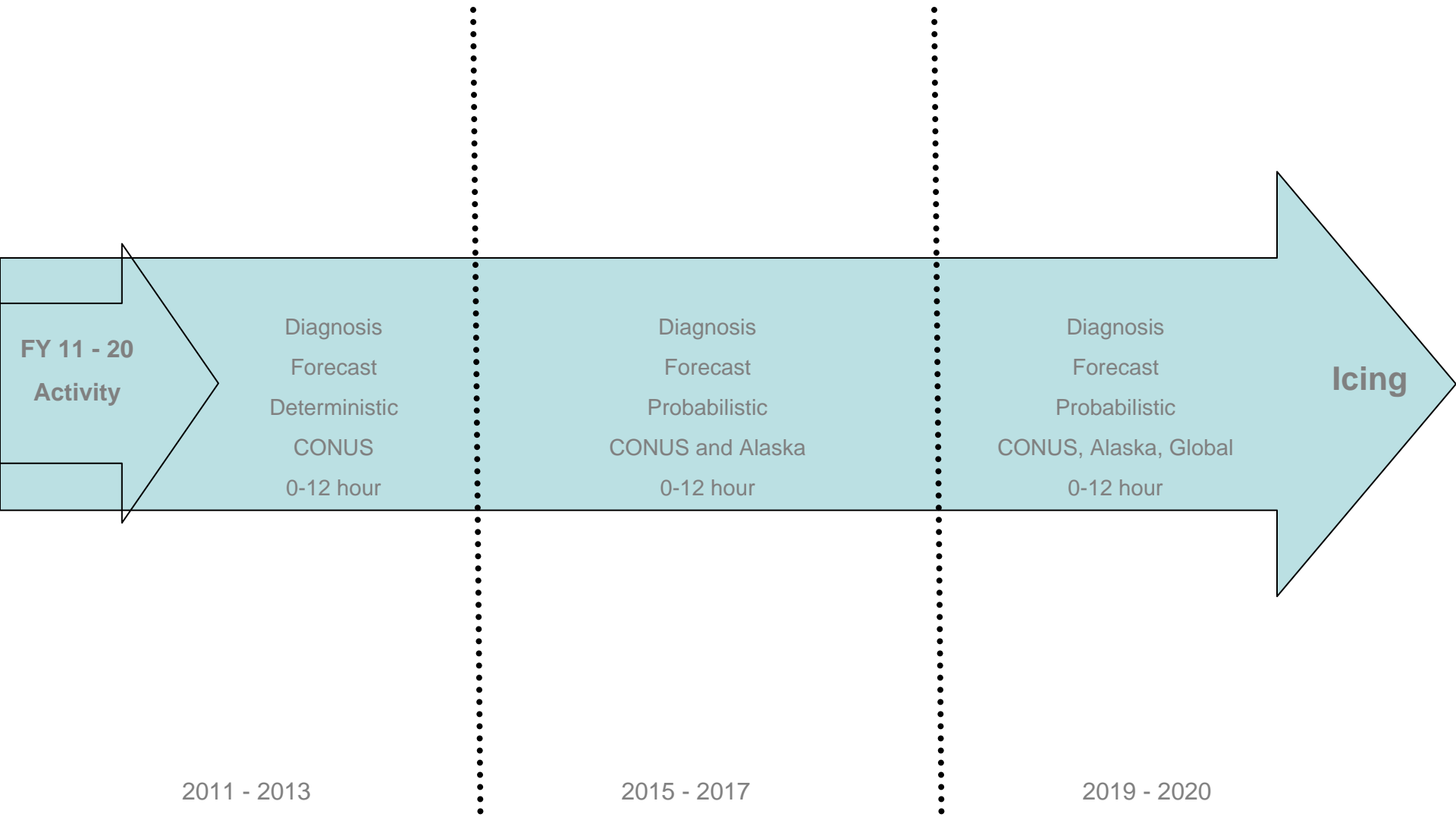


# NextGen Turbulence Plan

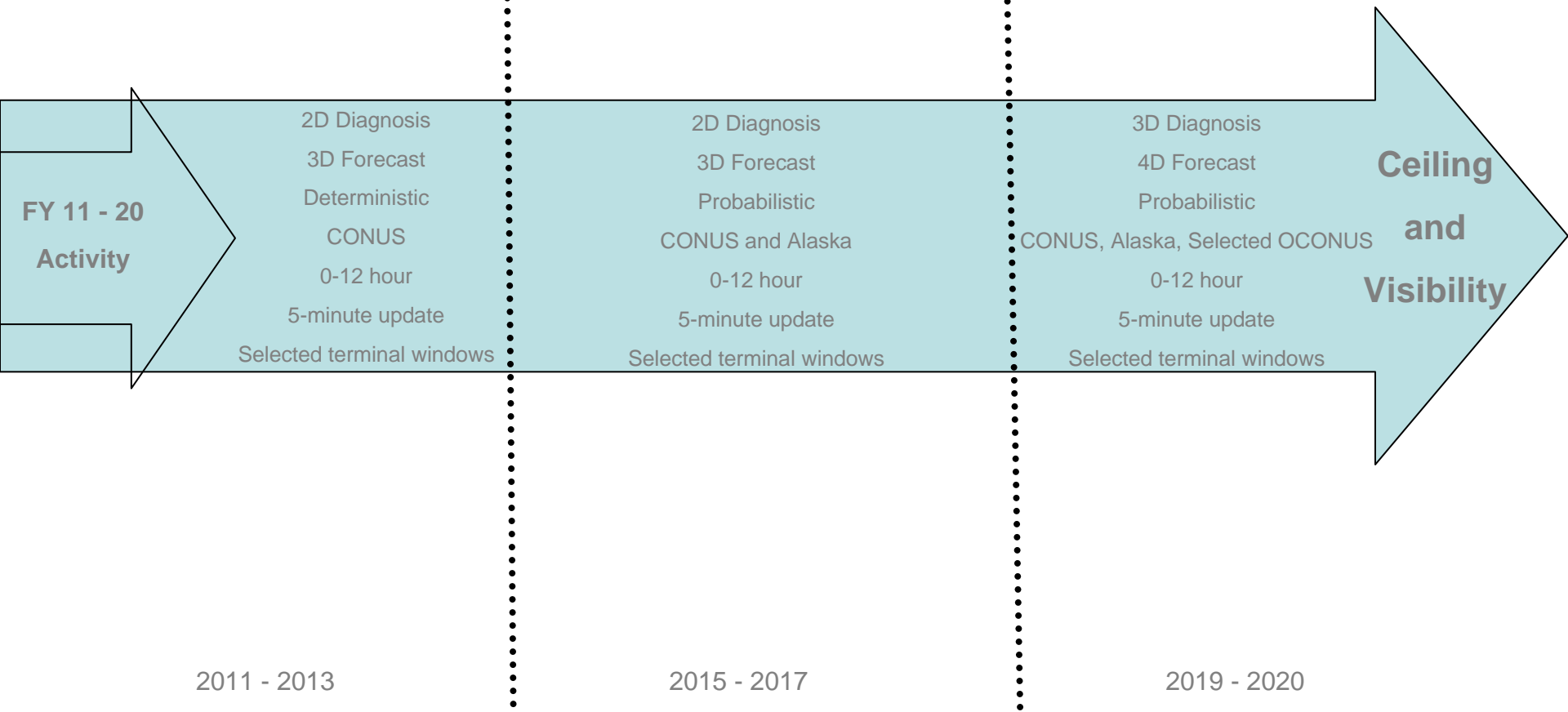




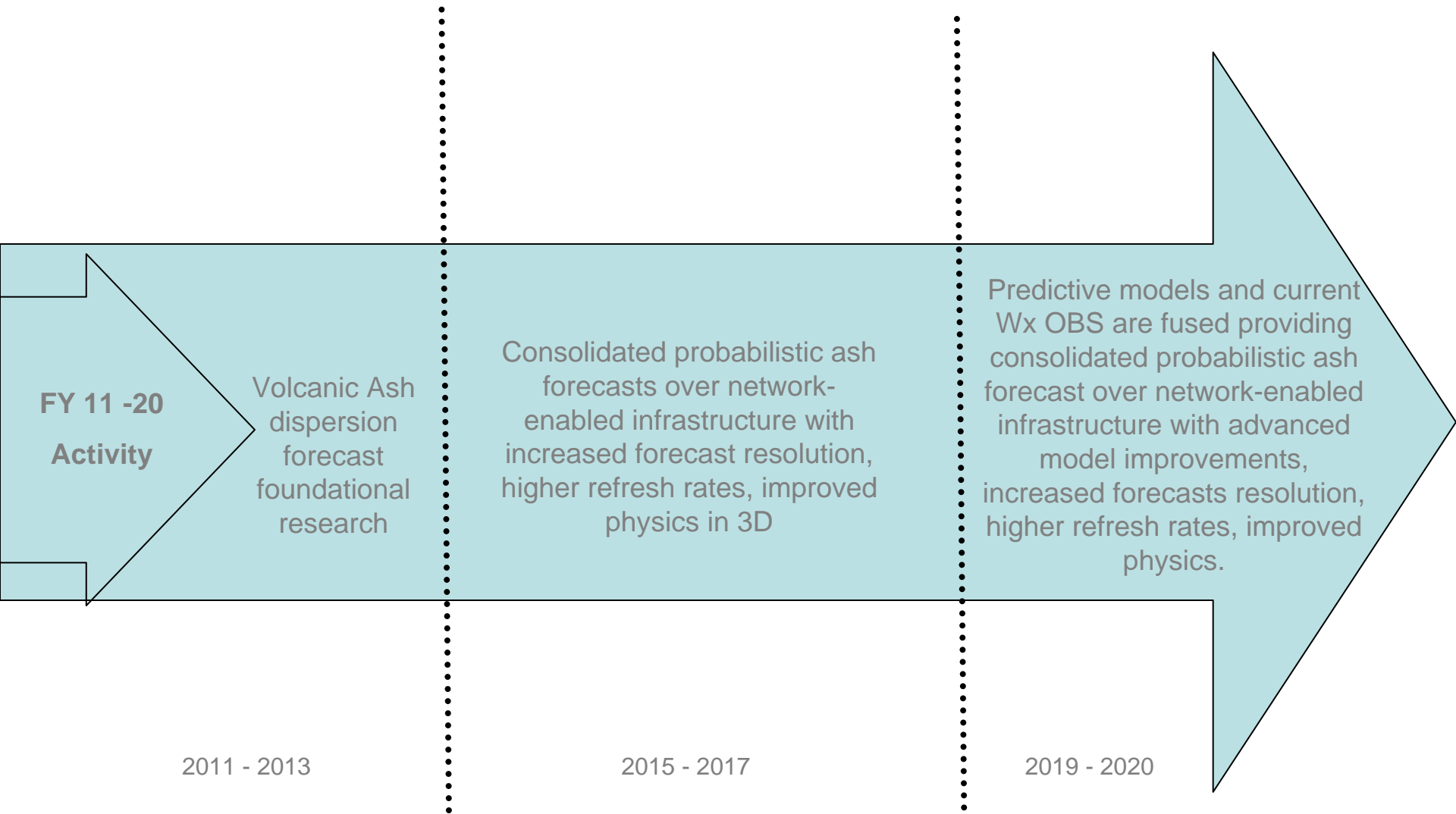
# NextGen Icing Plan



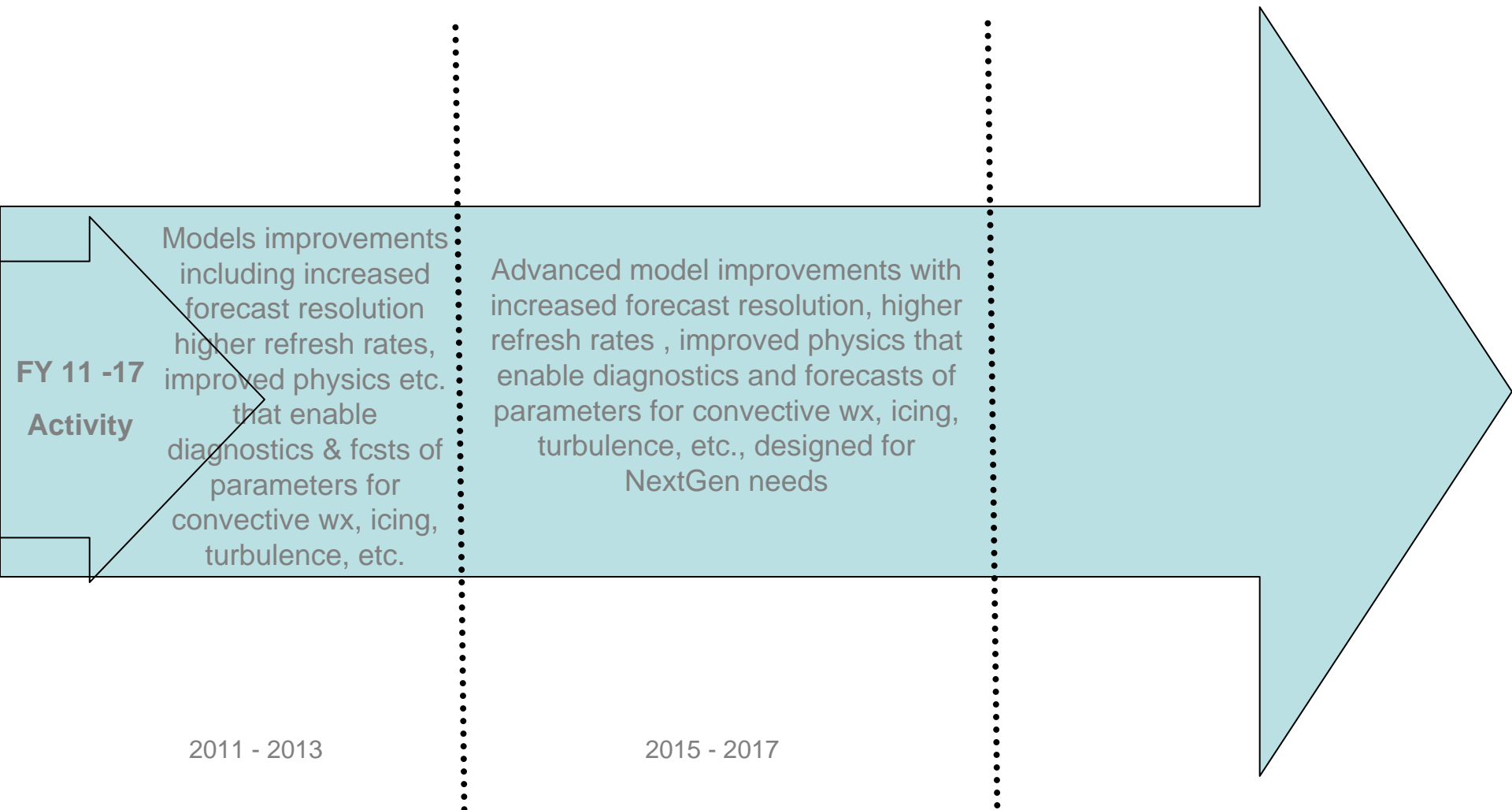
# NextGen Ceiling/Visibility Plan



# NextGen Volcanic Ash Plan



# NextGen Modeling Plan



# Summary

- **Evolution of AWRP Research will be IAW NextGen goals**
- **AWRP info will be evaluated by the NextGen Weather Evaluation Capability (NVEC) process**
  - Operational suitability
  - Human factors
  - Safety
  - Technical viability
- **AWRP software and data formats will be developed in accordance with NNEW guidance**
- **AWRP weather info will be transitioned by RWI into the NAS**

# Thank You

# Questions



# NWEC Entrance Criteria

## Criteria

- Mission Need Statement (MNS)
- Enterprise Architecture (EA)
- Functional Analysis (FA)
- Functional and Performance Goals (requirements)
- ConUse
- Roadmap
- Verification Reports
- Documentation
- Initial Research Evaluation Plan



# NWEC Entrance Criteria (cont'd)

## Management Criteria\*

- Budget requirements
- Resource Requirements
- Benefits
- Costs
- Risks and risk mitigation strategies (programmatic, technical, operational, etc.)
- Schedule

\* For FAA Implementations

